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THE ABSTRACTING AND INDEXING OF BIOLOGICAL LITERATURE[1]

WHEN Dr. Lillie asked me to discuss some phase of the general abstracts-indexes-bibliographies problem in one of these evenings I hesitated considerably before accepting because it appeared to me such a discussion would be rather foreign to the general character of these evenings, occupied, as they are, primarily with the results of biological or related research. However, it was rather because of this difference that I ventured to accept. I found a certain justification on the ground that if in the main these evenings are given over to the reporting of advances in knowledge, one evening might conceivably be profitably devoted to a consideration of whether we are preserving these advances in such a way that the greatest use may be made of them with a minimum expenditure of time, energy, and funds. We expend considerable funds and enormous amounts of energy and time in ascertaining new facts and publishing them *in extenso*. I believe it is pertinent to inquire whether we have established adequate means for so recording these facts that the greatest and most economical use is made of them and progress made as largely cumulative as possible.

No doubt some of you are wondering what special license I have to discuss this problem. I can answer only that I have none. My contact with the subject has been a brief one. I happen to be one of a number who for the past four years have been carrying some of the responsibility in connection with *Botanical Abstracts*, and as such have been impressed with the magnitude of the problem of properly recording our information and have become convinced that in a large measure we have not in

[1] An invitation paper given at the Marine Biological Laboratory, Woods Hole, Massachusetts, August 4, 1922.

our present methods reached a fundamentally correct solution of this important problem.

The ideal—I take it all are agreed here—is to have all new information so recorded that any part of it, major or minor, can be located promptly and certainly. Classified bibliographies and indexes, in book or card form, abstracts with subject and author indexes in book form, etc., are some of the means in use to approximate this ideal. I should make it clear that I am here discussing only the recording of information, not criticism.

A review of most of these agencies, at least the biological ones, shows that they have been very inadequately supported, have been able at best to do the work incompletely, great as has been the service they have rendered. And, perhaps more important, continuity, because of inadequate financial support, has not been guaranteed, with the result that agencies have arisen, grown to great usefulness, declined, and disappeared, to be followed by gaps before other agencies have got under way. The result is that biological literature is not only inadequately recorded, but it is recorded in so many places that the task of rather exhaustively consulting the literature on many biological subjects is indeed exhausting. Moreover, an enormous amount of duplication exists, all agencies in the same general field covering the literature in well-known journals, but frequently being forced to neglect that in the less well known.

I believe it is worth while to inquire into the fundamental causes of the difficulty and just what sort of service the present worker demands. As the number of research journals and the amount of material published have steadily increased it has become more and more impossible for the individual worker personally to subscribe for an appreciable amount of the literature in his field. More and more he is depending upon bibliographic and abstract services to bring to his attention the contributions he must consult critically. It could not be otherwise. But in general the workers desire to own these bibliographies or abstracts, especially the latter, as they constitute, if well done, a sort of master key to the literature. I believe I am correct in saying that usually workers prefer a good abstract journal covering their field to a single or even several research journals. Granting that workers need and want most of all adequate abstract and index services, it is clear that if they are to avail themselves fully of such agencies these must be procurable at prices within their reach. In other words, the cost of the service must be relatively low—very low for most of us. Secondly, the service must approximate completeness. It should be of such character that reliance can be continuously placed on it to report adequately practically all the literature. Thirdly, the service must be prompt; the demands of the worker on his abstract journal are much like those on the newspaper. Fourthly, there should be reasonable guarantees of the continuity of the service.

As regards completeness and adequacy, I believe only one type of service has been developed which is generally satisfactory and that is the abstract journal with detailed indexes. Classified bibliographies, even though based on an examination of the texts, can at best but incompletely record the new information, though their utility has been and is very great, especially for libraries. In some instances, notably in the case of libraries, classified bibliographies in card form are preferred; but for individuals the expense and labor involved in filing and files have not made these very popular. Moreover, such bibliographies are cumulative and not periodic. The same objections presumably hold for abstracts in card form. Another objection to the latter is that it is difficult to accompany them by a usable detailed subject index.

The reason for the popularity of abstracts with detailed indexes is obvious. Unlike bibliographies, abstracts, if well prepared, quickly give the reader definite information as to the exact content of contributions. In many cases the titles can not do this even though formulated with care; and many of them are not formulated with care. Indeed, many are distinctly cryptic. From complete abstracts virtually complete subject indexes can be prepared, based, of course, on a careful analysis of the abstract as well as of the title. By and large, the complete subject index is perhaps of the greatest importance. But its preparation necessitates complete abstracts, unless indeed the indexing should be done wholly from the

originals—which would not at the same time yield the much desired abstracts, indispensable for current and reference use. It seems logical, therefore, to prepare the abstracts, and from them the indexes. Annual indexes furnish periodic reference sources which may be cumulated from time to time, as desired, to furnish the cumulative reference sources.

If we are correct that the most useful instrument in general is the abstract journal, how are we to produce it completely, thoroughly, promptly, continuously and sufficiently cheaply to answer the requirements? Obviously the task requires funds.

At present there are a great many abstracting journals in biology, not to mention scores of research journals that make more or less abortive attempts at abstracting. The subscription list of each is small, as most of them serve small groups. We have set up a great many special abstracting journals—in bacteriology, physiology, entomology, endocrinology, systematics, phytopathology, etc., etc.,—in most cases without correlation, with the result that each can claim only a small list of subscribers and is forced to charge a high subscription rate. It is a fact too often lost sight of that composition, or type-setting, is expensive and that its cost per page is the same whether one or one hundred thousand copies are printed. The fewer the subscribers, the larger the share of composition charge each must bear. With a large subscription list, the amount borne by each becomes negligible and a copy costs little more than the paper, press work, binding, and distribution. An abstracting journal with a subscription list of one thousand or fifteen hundred, as is the case with most of them at present, can not hope to yield a surplus sufficient to carry on the large amount of exacting routine necessary in a good abstracting journal. Little wonder, then, that almost all our special biological services are embarrassed financially and unable to carry their work forward as it should be carried.

Let us at this juncture examine what has been and is being accomplished by another science group going at the problem in another way. I refer to the chemists, who are probably handling the proposition more successfully than any other group. Instead of abstracts of industrial chemistry, organic chemistry, pharmaceutical chemistry, analytical chemistry, inorganic chemistry, etc., etc., they have one chemical abstracts. They have made it one of the official organs of the American Chemical Society and thus insured a minimum circulation of well over 13,000. The following are the remarkable facts in this undertaking: *Chemical Abstracts* publishes annually approximately 5,000 pages of probably the best abstracts and indexes produced anywhere; it maintains an editorial office, consisting of an editor-in-chief, two associate editors and a clerical staff, and pays its abstractors at a per page rate, at an annual cost of approximately $26,000; but even so, the journal is produced at an annual cost of about $6.80 per member, this including entire cost of manufacture and distribution, support of the editorial office and compensation of abstractors.

Consider for a moment another journal, *Botanical Abstracts,* with which I happen to be familiar. It prints about 1,200 pages of abstracts annually at a cost of $12.00 to each of its 1,100 subscribers, and has not only yielded no income for editorial purposes or for compensating abstractors, but instead has been accumulating a deficit. In other words, *Chemical Abstracts* publishes four times as much material at less than half the price and is able to carry its work forward continuously and efficiently and be relatively free from serious financial embarrassment. Most of our special abstracting journals are being carried on by a few enthusiasts willing to devote much time and energy without compensation. But, however willing these individuals may be, such organizations are subject to frequent partial or complete breakdowns. Their continuity and uniform quality have no reasonable guarantees.

Is it possible for the biologists to profit by the experience of the chemists and achieve something equally good or better in the way of this important accessory mechanism? At once we realize that the biologists lack an organization sufficiently comprehensive and strong to grapple with so large and difficult a problem. There are in this country fifteen to twenty societies of biologists with an aggregate member-

ship of over 6,000, but, with the exception of the Federation of American Societies for Experimental Biology which involves four societies, these have been almost wholly uncorrelated.

Recently, however, there has developed a movement which may provide an organization comprehensive enough to measure up to the task. I refer to the proposed federation of American biological organizations which are of a research character and which are essentially national in scope. This movement, as seems not generally realized, began over a year ago when the Botanical Society of America, the American Society of Zoologists, and the American Society of Naturalists endeavored to work out some plan to provide for the organization desired by the geneticists without at the same time increasing the already large number of separate and distinct biological organizations and thereby making it still more difficult to handle problems of common concern to all biologists. It was recognized that the opportunity for the organization of special groups must be provided, but also that there are certain large problems which can be properly handled only by a larger, stronger organization, including, if possible, all the societies. As regards the immediate problem of the genetics organization, the committee of the three societies recommended that sections in genetics with common officers be created in both the American Society of Zoologists and the Botanical Society of America. This recommendation was carried out by both societies, and programs of the joint sections were held at Toronto.

The committee went further, however. It recognized that similar organization problems would continue to arise and that something should be done to make such organization of special groups possible and at the same time maintain a certain solidarity of biologists for handling problems of common concern requiring concerted action for their successful solution. It was felt that this could be accomplished by a federation of at least the national research biological organizations.

The Division of Biology and Agriculture of the National Research Council was requested to call an informal conference at Toronto of officers of the national societies to consider the possibility of a federation. This meeting was held[2] and, after a general discussion, it was voted to hold an adjourned meeting in Washington in the spring. This was held in April of this year[3] and was participated in by official representatives from the following organizations:

American Society of Zoologists.
American Genetic Association.
American Society of Naturalists.
American Phytopathological Society.
Ecological Society of America.
Botanical Society of America.
American Society for Horticultural Science.
Society of American Foresters.
Society of American Bacteriologists.
American Association for the Advancement of Science, and its Sections G, F, O, and N.
American Association of Economic Entomologists.
American Society of Agronomy.
Entomological Society of America.
Federation of American Societies for Experimental Biology.
American Dairy Science Association.
American Society of Animal Production.

An executive committee *pro tem.* was appointed to draw up a constitution to be submitted this fall to the societies represented in the federation conference. While I am not authorized to speak for the committee, I think it may be said with perfect propriety that the federation, if established, will not in the least affect the autonomy of the member societies and that it will concern itself with problems of common concern to biologists.[4] The Washington conference recognized that one of these problems, perhaps the chief one at present, is publication, and, in particular, abstracts. It therefore appointed a committee to study the problem of providing all of biology with adequate abstracting and indexing services. This committee is a joint one, half appointed by the Conference and half by the Division of

[2] See Shull, A. F.: "The Proposed Federation of Biological Societies," SCIENCE, 55, 245-246, 1922.

[3] See Shull, A. F.: "Proposed Federation of American Biological Societies," SCIENCE, 56, 184-185, 1922.

[4] See Shull, A. F.: "Proposed Federation of Biological Societies," SCIENCE, 56, 359-361, 1922.

Biology and Agriculture of the National Research Council, and consists of the following:

Representing the proposed federation: A. Parker Hitchens, D. R. Hooker, C. A. Kofoid, I. F. Lewis.

Representing the Division of Biology and Agriculture: E. D. Ball, C. E. McClung, J. R. Schramm, A. F. Woods.

This committee is at work ascertaining the exact situation in abstracting, indexing, and other agencies for recording biological information throughout the world. Several facts are already obvious. Considering for the moment only the agencies published in English, we have in this country *Abstracts of Bacteriology, Index to the Literature of American Economic Entomology, Botanical Abstracts* (containing in addition to plant research animal cytology and genetics), *Endocrinology,* etc.; in England, *Physiological Abstracts, Review of Applied Entomology, Review of Applied Mycology, Zoological Record* (Part N of the International Catalogue of Scientific Literature), etc. The subscription list of each is small and in many cases the financial support is inadequate to insure that the work will be done thoroughly and in perpetuity. Zoology especially seems in a precarious position since the breakdown of continental agencies and the suspension of the International Catalogue, with the exception of Part N (Zoology), which, however, is financially handicapped. Only in physiology and entomology, and perhaps genetics, is the situation reasonably satisfactory at present. Many of the agencies are hanging on a relatively slender thread; some are likely to break down at almost any moment, indeed, are breaking down. The question is, shall we continue to leave the recording of biological information, only a mechanism, to be sure, but an absolutely indispensable one, to such a precarious existence?

Primarily there appear to be two methods of handling the situation. (1) The present one of a large number of special abstracting journals or bibliographic services. For such special journals there is a relatively small demand and a correspondingly small support. Here, too, it should be pointed out that the more numerous the journals and the narrower the field covered by each, the greater the amount of duplication—necessary duplication under this system since each specialty grades insensibly into neighboring ones on which it depends to a large extent. Furthermore, the conventional line so often drawn between plants and animals is no longer recognized in many lines of work, and rightly so. Separate botanical and zoological abstracting journals will not satisfy the geneticist or cytologist, and only imperfectly many pathologists, physiologists, and ecologists. (2) The other method is the publication of a single comprehensive biological abstracts, corresponding to *Chemical Abstracts.* Let us consider the second alternative in more detail.

(1) *Cost.* The joint committee has not yet completely determined the approximate volume of biological literature, after delimiting it roughly from clinical medicine, chemistry, physics, geology, psychology, etc. But it is safe to assume that it is at least as large as chemical literature. Let us assume, then, that a journal fully as large as Chemical Abstracts (5,000 pages annually) would be required. If such a journal were made the official organ of the proposed Federation, going to each member of the constituent societies as Chemical Abstracts goes to each member of the various sections of the American Chemical Society (thus insuring a subscription list of 7,000 or 8,000), I believe I am safe in saying on the basis of information in our hands on manufacturing costs that such a journal would cost little or no more than most of the special abstracting journals and considerably less than some of the larger ones like Botanical Abstracts. In other words, a very large journal with a large subscription list would cost less per subscriber than a small one with a small subscription list. Let me remind you again of Chemical Abstracts with its 5,000 pages annually and an overhead of $26,000 yearly produced at a cost of $6.80 for each member.

It may be objected that most biologists would be interested in but a small part of such a comprehensive journal. The same thing may be said of Chemical Abstracts. I doubt whether there would be greater diversity than in Chemical Abstracts, which includes anything from

routine commercial analysis to theoretical physical chemistry. The material would, of course, be organized into sections according to the judgment of the biologists and the section or sections of interest could be as easily consulted as in a special journal. This objection resolves itself, I believe, into the relatively small item of space occupied on the shelf; this may perhaps be met by some plan of issuing parts without involving a sacrifice of the fundamentally important principle of uniform support by all members of the constituent societies of the proposed Federation.

(2) *Duplication.* Most of the duplication existing in special abstracting journals would be done away with and the problem would narrow itself down to the necessary overlapping with a few large abstracting journals in the other major fields—chemistry, physics, etc. Moreover, with such a widely distributed abstract journal, research journals might well discontinue their abstract sections and either devote such space to the publication of additional research, or to criticism, or both; or effect a reduction in size, and consequently in cost.

(3) *Cross referencing.* Though the material be segregated into special sections, as many as necessary, suggestive and pertinent material from other sections could be conveniently referred to by cross references, each sectional editor having complete control over cross references by having access to a complete duplicate galley proof. (In the special journals this can be done only by duplicating in large measure the abstracts appearing in other specialized journals.) This cross-referencing would make possible the very complete utilization, with practically no expense, of the valuable leads from related fields on which so much of progress depends.

(4) *Current files.* A single, large, strong journal could acquire by exchange or purchase much of the current serial literature in which its material appears. *Chemical Abstracts* now receives 550 serial publications, by exchange and purchase, which are available for abstracting purposes. The small journal does not have the resources to accomplish this, and yet such files are indispensable for properly carrying on the work. It is to be hoped that some day all American abstracting agencies at least may be brought into correlation in order that they may share each other's facilities; all the services would inevitably profit by such correlation.

(5) *Support.* Fundamental to the ultimate success of such a comprehensive undertaking would be the adoption of the journal as an official organ of the proposed Federation. Granting that it can be manufactured, as I believe it can, for from $6.00 to $8.00 annually, I am inclined to believe that practically all of us would be willing to pay that amount annually for a virtually complete abstracting and indexing service of the world's literature in our respective fields, especially when it brings in addition equal service in other biological fields in which we have an interest. If this were done, in other words, if a Biological Abstracts, or whatever you choose to call it, had the solid backing of the biologists of America at least, support, perhaps a permanent endowment, might be secured sufficient to cover the overhead, in which case the journal could be sold for practically manufacturing cost. Moreover, such an endowment would reasonably guarantee that the work would go forward properly under practically all conditions. There is little hope that the numerous separate journals with small backing can command such support. Indeed, the history of these shows that they can not.

Let me make it clear, however, that the joint publications committee has no power. Its function is to ascertain and report the facts. The decision rests with the societies. The committee is by no means ready to report, and I have little idea as to what will be the nature of its report when all factors have been taken into consideration. But I personally venture to predict that the permanent solution of the problem lies in the direction of the establishment of a single biological abstracting journal having the unified support of all, or practically all, American biological organizations at least. Obviously, such a solution would necessitate the merging of several existing biological abstracting and bibliographic agencies, and this, of course, should not be done unless it is certain that a real improvement will be effected thereby. We may rest assured that those controlling the ex-

isting journals will not proceed in this direction until such guarantees are forthcoming.

J. R. SCHRAMM
NATIONAL RESEARCH COUNCIL,
WASHINGTON, D. C.

DOES NITRIFICATION OCCUR IN SEA WATER

DESPITE the meager, observational and experimental data which are available on the subject, the idea of the occurrence and activity of nitrifying bacteria in the opea sea is widely prevalent among bacteriologists and botanists. This idea is based, in part, on the reasoning that ocean water should contain the bacteria discharged into it by the sediments and the drainage waters from terrestrial sources; more particularly, however, it is an outgrowth of certain studies which have been made in recent years on the bacterial flora of sea water which, as above indicated, are far from exhaustive and satisfying. For example, Thomsen[1] has discovered nitrite and nitrate producing bacteria in the ooze of the bottom of Kiel Fjord. It has also been reported that nitrite and nitrate forming bacteria have been found in the slime at the bottom of the Bay of Naples. In both cases, however, it is definitely pointed out that the samples studied were obtained from near land surfaces. Moreover, Thomsen failed to discover the nitrite or nitrate forming organisms in sea water or in the plankton or the fixed algæ. In commenting on the studies of Keding[2] and Keutner[3] on nitrogen-fixing bacteria of the sea, Drew[4] made the following statement which shows him to have been confused on the subject of two distinct groups of bacteria wholly different from each other in all respects. He said, "The existence of *nitrifying* bacteria which are *capable of absorbing and combining with the free nitrogen of the* air[5] and eventually give rise to nitrates, has been shown by Keding and Keutner, but these have so far only been found in the bottom close to shore or apparently living in symbiosis with algæ or plankton organisms." Later on, however, Issatchenko,[6] whose original papers are not available to me, claims to have found nitrifying bacteria in the Gulf Stream near Ekaterininsk 72° N. He observed, however, that the presence of such bacteria in the Arctic Seas is still unproved. Issatchenko made this statement eight years after having stated, as reported in a brief note,[7] that he had discovered a nitrifying bacterium in Arctic sea water. With these unsatisfactory results before him, Berkeley[8] decided, in the course of other studies on marine bacteria, to make some tests for a possible nitrifying power of sea water. He inoculated 2 per cent. solutions of ammonium sulfate in sea water with samples of the sea water to be studied. He does not state how much inoculum was employed, nor anything else relative to the technique of the experiments, but the result was that even after three months none of the cultures showed even traces of nitrite or nitrate.

In connection with a series of critical studies on the possible connection of bacteria with $CaCO_3$ precipitation in sea water, which are to appear in the reports of the Department of Marine Biology of the Carnegie Institution of Washington, the writer of this note, unaware of Berkeley's work which appeared at about that time, determined to make some tests for the possible nitrifying power of sea water.

[1] Thomsen, R.: "Ueber das Vorkommen von Nitrobakterien im Meere," *Wiss. Meeresunters*, Vol. XI, Kiel.

[2] Keding, M.: "Weitere Untersuchungen über stickstoffbindende Bakterien," *Wiss. Meeresunters*, Vol. IX, Kiel.

[3] Keutner, J.: "Ueber das Vorkommen und Verbreitung stickstoffbindende Bakterien im Meere," *Ibid.*, Vol. IX, Kiel.

[4] Drew, G. Harold: "On the Precipitation of Calcium Carbonate in the Sea, etc." *Papers from Tortugas Laboratory*, Carnegie Inst., Wash., Vol. 5, 1914.

[5] Italics mine.

[6] Issatchenko, B. L.: "Nitrogen Fixation, Nitrification, Denitrification and Production of Hydrogen Sulphide by Bacteria in the Arctic Ocean." *Rev. Agr. Expts.*, Vol. 17, pp. 175-9. Cited in *Bull. Agr. Intelligence*, 7, 1753 (1916).

[7] Issatchenko, B. L. Cited from *Centr. Bakt. etc.*, 2th Abt., No. 13-14, p. 430, 1908.

[8] Berkeley, Cyril: "A Study of Marine Bacteria, Straits of Georgia, B. C." *Trans. Roy Soc. Can.*, Vol. 13, p. 15.

The first tests were carried out at Pago Pago in American Samoa, but they were later supplemented by several tests at Berkeley, California, with material collected in Samoa. In the tests just mentioned, the ordinary Omeliansky solutions for nitrite and nitrate formation were employed, and they were inoculated in two series, one with sea water and the other with calcareous sand taken from beneath that same sea water. Twenty-five cc. portions of sea water and about one gram of the calcareous sand were used as inocula. After three weeks, there was no trace of nitrite or nitrate in the sea water inoculation, but very good nitrification in the calcareous sand inoculations. The first result is, therefore, in agreement with that of Berkeley, though reached in ignorance of Berkeley's experiments. It will be noted, however, that Berkeley used sea water media containing 2 per cent. of $(NH_4)_2SO_4$, which is very different from the weak salt media of the Omeliansky solution which contains only .1 per cent. $(NH_4)_2SO_4$. In fact, there seems to be no real reason for the use of such high concentrations of ammonium sulfate, and especially in the presence of a concentrated salt solution like sea water. Nevertheless, the agreement in the results of the two tests is noteworthy. Before discussing further the significance of my second result, namely, with the calcareous sand inoculations, it is best to describe some subsequent experiments. Thinking that the period of incubation may have been too short in the sea water cultures above described, since the nitrifying bacteria could not in any case be expected to be present in sea water in great numbers, I repeated the experiments on my return to California from Samoa, and allowed the culture to run for eight months in one case. The results were, however, just the same as in the first series. The inoculations with sea water gave no tests for nitrite or nitrate, and the inoculations with calcareous sand taken directly below that sea water gave marked nitrification.

Even these tests did not entirely satisfy me, however, because I still thought that the number of nitrifying bacteria in sea water might be so small as to render possible their total absence from a 25 cc. sea water inoculum. An opportunity to make further tests came, however, during my continued studies on marine bacteria and the lime precipitation problem during the past summer (1922), this time at the Tortugas Laboratory of the Carnegie Institution of Washington. On June 9, two 150 cc. portions of Omeliansky's solution were placed in one liter Erlenmeyer flasks and sterilized. When the culture solutions were cool, they were inoculated as follows: one with about ten grams of calcareous sand obtained from the sea bottom near the Loggerhead Key shore; the other with 150 cc. of sea water obtained immediately above the calcareous sand. On June 16, tests were made with Trommsdorff's reagent of the cultures, which were incubated at room temperature (about 27° to 31° C. constantly). No test for nitrite was obtained in either culture. On June 22, the tests were made again. This time, the calcareous sand inoculation showed marked nitrite production, whereas the other culture showed nothing. A further test made on July 21 gave the same results as that on June 22.

All of these tests, taken in conjunction with those of Berkeley and possibly those of Isaatchenko, compel us to the conclusion that either the nitrifying bacteria are absent from the sea water, or they can not function in such concentrated salt solutions. The former alternative is probably the correct one, since it will be remembered that my first tests were with much weaker salt solutions, and as Miss Meek and I have shown in a paper soon to appear in the *Journal of General Physiology*, the nitrifying bacteria can withstand very high salt concentrations. It may, therefore, be concluded with reasonable safety that the nitrifying bacteria are absent from open sea water and that, therefore, no nitrification occurs in such sea water. What may be the state of affairs in small areas of the sea close to land and harboring much organic matter is not directly relevant to this particular inquiry. I hope to secure some information on that point soon.

Not the least interesting feature of my tests on this question, however, is the result obtained with the calcareous sand inoculations. It is remarkable that calcareous sand, which is in constant contact with sea water, should har-

bor vigorous nitrifying organisms, whereas that sea water with which it is in equilibrium in the system should not. It is difficult to account for this, except by assuming that the solution surrounding the sand particles is of a very different nature from that in the sea water above, and yet the possibility of that seems rather remote. Of course small amounts of organic matter covering the sand particles may afford protection for the bacteria. Further experiments which I am conducting may throw some light on this question.

CHAS. B. LIPMAN
UNIVERSITY OF CALIFORNIA

A RECENT SCIENTIFIC EXPEDITION TO THE ISLANDS OFF THE WEST COAST OF LOWER CALIFORNIA

AT the Berkeley meeting of the Pacific Division of the American Association for the Advancement of Science in 1921 there was appointed a Committee on Conservation of the Marine Life of the Pacific, Dr. Barton Warren Evermann, chairman. One of the first tasks which the committee undertook was the making of recommendations for the protection of certain of the marine mammals or for the gathering of necessary information which would make it possible to advocate a concrete plan in the future. With regard to certain species, there already existed sufficient data so that definite action could be undertaken at once, but with other species practically nothing was known of their present status. This was notably true of the Guadalupe elephant seal, Guadalupe fur seal and southern sea otter, all of which once existed in great abundance along the shores of California and Lower California.

Through the activities of the committee, an expedition was dispatched from San Diego to the islands off the west coast of Lower California on July 9, 1922, for the primary purpose of securing data on the three above mentioned species of mammals. The government of Mexico provided the fisheries patrol boat *Tecate* for the work and met all expenses while the party was in the field. Professor Carlos Cuesta Terron, curator of fishes and reptiles of the National Museum of Mexico, was in charge of the expedition and the Mexican government was further represented by Professor José Mª Gallegos, of the National Museum, Srs. Joaquin Palacios, inspector, and Rudolfo Lascano, assistant inspector of lighthouses, Sr. Enrique Gonzalez, fisheries inspector, and Sr. Luis Rubio, taxidermist.

Through the intercession of Dr. A. L. Barrows, of the National Research Council, the National Geographic Society rendered financial assistance which made it possible for the committee to enlarge the scope of its work by securing the cooperation of the California Academy of Sciences, represented by Mr. Joseph R. Slevin, assistant curator of herpetology, Mr. Frank Tose, chief taxidermist, and the writer; of the San Diego Society of Natural History, which sent Mr. A. W. Anthony, curator of vertebrates, and Mr. Ernest Hinkley, assistant; and the Scripps Institution for Biological Research, represented by Mr. P. S. Barnhart. Mr. Anthony and the writer were placed in charge of the scientific investigations.

The motor ship *Tecate* was admirably suited to the work in hand and the success of the expedition was in no small measure due to the constant interest of Captain Victor Angulo and his well trained crew. Everything possible was done to aid the observers and collectors during the five weeks in the field.

The expedition returned to San Diego on August 16, after having visited the following islands: Guadalupe, San Martin, Cedros, the San Benitos, Natividad, San Roque, Asuncion, Magdalena and Santa Margarita. Landings were also made at Ensenada, San Quintin Bay, San Bartoleme Bay and Abreojos Point on the Lower California peninsula. Besides making collections at all of these places the coast line was studied at close range for considerable distances from the vessel, particularly the bight known as San Cristobal Bay, where elephant seals are known to have once hauled out in numbers.

The herd of elephant seals on Guadalupe Island was carefully studied and counted and, although the results can not as yet be announced, it may be stated that conditions were very encouraging for the perpetuation of this remarkable species. Many interesting photographs, including motion pictures, were taken of the animals.

The entire coast lines of Guadalupe and several of the other islands were examined carefully for evidence of the existence of the Guadalupe fur seal but not a single animal was seen. Many inquiries were also made regarding the species but no information was obtained which would indicate that there remained a living representative. It has apparently gone the way of the great auk, Steller's sea cow and several other valuable species; commercial hunters can cut another notch on their gun-stock.

The old fur-seal rookery grounds of Guadalupe were examined carefully. Three of these were found and the lava rocks were polished as smoothly as though they had been deserted but yesterday. An estimate based upon knowledge gained on the Alaska fur-seal rookeries placed the original number of animals on Guadalupe at 100,000. The great killing took place in the early part of the nineteenth century and we must look with remorse upon our ancestors who were so thoughtness as to destroy so valuable an animal. In 1892 and subsequently several expeditions have visited Guadalupe Island in the hope of securing specimens for museum purposes but met with no success. Four incomplete skulls upon which the species was founded and possibly a few disassociated bones (yet unidentified) taken by the last expedition seem to represent all there is of it except regrets.

No southern sea otters were seen by the members of the expedition, but information obtained would indicate that there are still alive a very few of these excessively valuable animals.

The natural history collections made by the expedition were large considering that the islands were visited during the dry season. Specimens in various groups were obtained in approximately the following numbers: birds and mammals, 300; reptiles and amphibians, 1,000; insects, 1,100; land shells, 2,000; marine fossils, many; and miscellaneous fishes, invertebrates and plants.

The representatives of the Mexican government are thoroughly alive to the necessity of conserving the natural resources of their western territory. It is not expected that measures will be adopted which will throttle the proper commercial development of the vast wealth of marine life of those waters but it is expected that the Mexican government will provide laws and regulations which will properly safeguard and conserve those resources so that they may continue for all time valuable assets of that government.

G. DALLAS HANNA
CALIFORNIA ACADEMY OF SCIENCES

AID TO RUSSIAN SCIENTISTS

THE American Committee to Aid Russian Scientists with Scientific Literature made an appeal through SCIENCE (June 23, 1922) to the scientific men and organizations of the United States for gifts of American scientific books, journals and papers to be sent, by aid of the generous cooperation of the American Relief Administration, of which Mr. Herbert Hoover is chairman, to Russia for distribution among Russian universities, scientific organizations and individual workers. In addition to the general appeal through SCIENCE, the committee made a special appeal by letter to various commercial publishing houses, university presses and scientific organizations which publish journals, memoirs, bulletins, etc.

The response to this appeal has been widespread and generous. Up to date nearly nine tons of American scientific books, journals and papers published since January 1, 1915, have been collected and sent to Russia. The contributors include 70 government and state bureaus and experiment stations, 40 universities and colleges and university presses, 23 national and state scientific societies and about 120 private individuals. To make special mention of any contributors among the many who have made such generous response to the appeal may seem unfair, but to reveal the interesting fact that commercial publishing houses, which are presumably not primarily philanthropic, or, at least, immediately benevolent in their aims, have exhibited a generosity not inferior to that shown by the more strictly science-supporting organizations, I want to call attention to such examples of good will as shown by the Yale University Press in its contribution of six copies each of twenty-four first class scientific books published by it, and by Doubleday, Page and Company in submitting a list

of their publications and requesting the committee to choose what books it desired.

The only disappointment to the committee is that caused by the comparatively small number of private individuals so far represented in the list of donors. A partial explanation of this is undoubtedly to be found in the fact that the appeal was issued at just about the end of the academic year when many professors had left their laboratories for their summer vacation.

The committee wishes to express its thanks to all those organizations and persons who have responded to its call and to make known to these contributors an expression, recently received by cable, of the great gratitude of the Moscow representative committee of Russian scientists.

It also wishes to repeat its appeal to individual scientific workers for contributions of reprints to the number of six each, if possible, of their published papers since January 1, 1915. The committee has at its disposal only a limited fund to cover the necessary clerical work. It asks, therefore, that contributors of literature cover the cost of its transportation to New York, from which point all cost of handling and shipment will be borne by the American Relief Administration. Contributors should send, with each consignment, one copy of a list of the publications sent by them and five copies of this list (apart from the consignment) together with all letters containing advices of shipments, express and shipping receipts to the American Relief Administration, Russian Scientific Aid, 42 Broadway, New York City. The publications themselves should be sent by parcels post or express, or if very heavy, by freight, to the American Relief Administration, care Gertzen and Company, 70 West Street, New York City. Requests for further information should be sent to the American Committee to Aid Russian Scientists, 1701 Massachusetts Avenue, Washington, D. C.

The answer to one such request for information which has been received from numerous inquiries may be given here and now. The contributed material is not turned over to the Soviet government, nor is the distribution of this material determined by the Soviet government. The distribution is effected under the general direction of the American Committee by the American Relief Administration working in cooperation with a special committee in Moscow of Russian scientists representing various Russian universities and scientific organizations. The extraordinary independence of the American Relief Administration, extraordinary in the light of the existent circumstances, as regards its activities in Russia, is perhaps not generally realized here in America.

VERNON KELLOGG,
Chairman
L. O. HOWARD
DAVID WHITE
RAPHAEL ZON
American Committee to Aid Russian Scientists with Scientific Literature

SCIENTIFIC EVENTS

THE RECOVERY OF HELIUM

SATISFACTORY operation on a laboratory scale of a simplified and much cheaper method of recovering helium is reported through the American Chemical Society by H. Foster Bain, director of the U. S. Bureau of Mines. In a test made within the last month at the cryogenic laboratory in the Interior Department building, helium was recovered from natural gas in one operation in sufficient purity for use in dirigibles or balloons.

"This development," Mr. Bain said, "indicates that very soon commercial production of helium for lighter-than-air craft is probably feasible." Not only will this work insure safety from fire and explosions, but it is almost certain to result in an entirely new type of airship design. The motor, for instance, could be placed inside the envelope of a helium ship if necessary.

The research work leading up to this achievement was directed by the United States Helium Board, composed of Lieutenant Commander F. M. Kraus, representing the Navy, Colonel R. F. Favel, representing the Army, and Dr. R. B. Moore chief chemist of the U. S. Bureau of Mines, H. S. Mulliken, production engineer, alternate. The actual work of development was directed by a group of men known as the Board of Helium Engineers, with the following membership: M. H. Roberts, Franklin Railway Supply Company; R. C. Tolman, of

the California Institute of Technology; W. L. DeBaufre, University of Nebraska; Edgar Buckingham, of the U. S. Bureau of Standards, and John W. Davis, of the U. S. Bureau of Mines. The government also had the assistance of Dr. Frederick Keyes, Massachusetts Institute of Technology, and Dr. Harvey N. Davis, Harvard.

Helium recovery as carried on at government plants in Texas, results in a gas of about 64 per cent. purity, and necessitates a second operation to remove impurities. By the old method the flow from the natural gas wells is directed through a series of compressors which reduce the various gases in the mixture to liquid form. Methane (illuminating gas) becoming liquid at a higher temperature is taken off first. The remaining gases are then, one by one, liquified and helium, having an exceedingly low liquefying point, remains. The difficulty with this method is to liquefy all of the nitrogen in the mixture.

THE USE OF OXYGEN IN METALLURGICAL OPERATIONS

USE of oxygen in connection with the enrichment of the blast in the blast furnace and in practically all phases of pyro-metallurgical work will furnish the key to success in the further development of such metallurgical operations, according to Dr. F. G. Cottrell, formerly director and now consulting metallurgist of the United States Bureau of Mines, who first directed the bureau's attention to this subject. Through this enrichment process, it is hoped to increase the efficiency of metallurgical operation with a resultant production of metals at lower cost and possibly the use of lower grade ores.

The Bureau of Mines now has outlined plans for two studies which will be carried on simultaneously. The first will cover the present-day processes for the production of oxygen, in order to determine the feasibility of attempting to produce oxygen, or oxygenated air, in such amounts and at such a cost as to permit of its use in metallurgical operations. The second study will be devoted to the feasibility of using oxygen, or oxygenated air, in metallurgical operations.

Because of his interest in this investigation, M. H. Roberts, vice-president of the Franklin Railway Supply Company, was asked to select an advisory committee to work with the Bureau of Mines and to act as chairman of this committee. The committee will consist of Dr. F. G. Cottrell, director of the Fixed Nitrogen Research Laboratory; Professor W. L. DeBaufre, chairman of the mechanical engineering department of the University of Nebraska; Dr. D. A. Lyon, chief metallurgist of the Bureau of Mines; Dr. R. B. Moore, chief chemist of the Bureau of Mines; Dr. R. C. Tolman, professor of physical chemistry and mathematical physics, California Institute of Technology; J. W. Davis, mechanical engineer of the Bureau of Mines; F. W. Davis, metallurgist of the Bureau of Mines; Frank Hodson, president of the Electric Furnace Construction Company, and P. H. Royster, assistant metallurgist of the Bureau of Mines.

Previous to the war, some work was done in Belgium on the enrichment of the blast with oxygen in connection with the smelting of iron ores in the blast furnace. In the United States, the late J. E. Johnson, Jr., was interested in the possible use of oxygen in metallurgical operations and carried on some experimental work along these lines previous to his death.

ACOUSTICAL RESEARCH

THE London *Times* writes editorially in regard to the desirability of cooperation in the conduct of acoustical research as follows:

Architects are still unable to predict with certainty the acoustic properties of the halls and chambers they design. Commenting a few weeks ago on the failure in this respect of the new London County Hall, we suggested that bodies such as the Royal Institute of British Architects and the National Physical Laboratory might get together for the devising and conduct of experiments for future guidance. But, so far as we are aware, no practical steps have been taken in this country. Meantime similar problems are engaging attention in the United States, where, indeed, the late Professor Sabine, of Harvard, had already made valuable progress in exploration of the acoustic properties of architectural interiors. A scheme is on foot to establish an American Institute for Acoustic Research. Pro-

fessor C. A. Ruckmick, of Wellesley College, Massachusetts, to whom the proposal is due, calls attention to the progress which has followed combined intensive research in the photographic and lighting industries, and thinks that the time has come when equal advantages might be gained for acoustics. Already there exist more than a dozen American laboratories where investigations into different branches of the subject are in progress, but these could be encouraged and expanded by cooperation and concerted attacks on special problems. There is no doubt as to the scope of the work that might be undertaken. The acoustic qualities of confined areas, such as halls and chambers, improvements in telephone and phonograph reproducers, sound localization, consonance and dissonance are the mere headings of sections covering many subjects of scientific interest and practical value. We wish well to the American scheme, and would give a still more hearty welcome to a similar British scheme.

THE AMERICAN SOCIETY OF ZOOLOGISTS

THE American Society of Zoologists, in conjunction with Section F of the American Association and in association with other biological societies, will hold its twentieth annual meeting under the auspices of the Massachusetts Institute of Technology on Wednesday, Thursday and Friday, December 27, 28 and 29, 1922.

Zoological papers by persons not members of the society may be placed on the program on recommendation of a member of the organization. All titles should be in the hands of the secretary by November 22, accompanied by an abstract of not more than 250 words. Titles and abstracts for the genetics program should be sent to Professor L. J. Cole, Madison, Wisconsin, secretary of the genetics section of the society.

Abstracts of papers to be presented will be published for distribution before the meeting and will appear in *The Anatomical Record* for January, 1923. Non-members of the society who desire copies of the preliminary program and abstracts should notify the secretary immediately.

The biologists' smoker will be held on Wednesday evening in the Walker Memorial Building of the Massachusetts Institute of Technology. All biologists are invited. The zoologists' dinner will occur at the Parker House on Thursday evening. Professor Kofoid will give the address. All zoologists are invited.

The Parker House will be the hotel headquarters of the society. Fifty rooms are available at rates from $2.50 up. Reservations should be made directly with the hotel management.

W. C. ALLEE,
Secretary

ZOOLOGY BUILDING,
THE UNIVERSITY OF CHICAGO

SCIENTIFIC NOTES AND NEWS

DR. JACQUES LOEB, member of the Rockefeller Institute for Medical Research, has been elected an honorary member of the Société Royale des Sciences Médicale et Naturelles of Brussels.

DR. CASIMIR FUNK, associate in biological chemistry at the College of Physicians and Surgeons, Columbia University, has been elected a foreign member of the Halle Academy of Science in the division of scientific medicine.

DR. FREDERICK BELDING POWER, of the U. S. Bureau of Chemistry, has been awarded the Flueckinger gold medal by the Society of Swiss Chemists for "invaluable work on alkaloids and etheral oil."

THE first Warren Triennial Prize of $500 has been awarded for an essay on "The Circulation in the Mammalian Bone-Marrow," by Drs. Cecil K. Drinker, Katherine M. Drinker and Charles C. Lund, of Boston. A second prize was awarded to an essay on "The Effect of Roentgen Rays on the Nuclear Division," by Dr. James Mott Mavor, Union College. A second prize of $250 was awarded this year because of the difficulty in determining the relative merits of the first two papers.

LADY MANSON was the recipient on September 26 of the first presentation of the medal struck in memory of Sir Patrick Manson, from funds collected by the Manson Memorial Fund. This medal, which is in bronze, bears on the obverse a profile of Sir Patrick, and the device "Tropical Medicine and Hygiene." It will be presented triennially to any specially distinguished worked in tropical medicine, the re-

cipient to be selected by the council of the Royal Society of Tropical Medicine and Hygiene.

KING HAAKON of Norway has bestowed the Medal of Merit in gold on Dr. Ingeborg Rasmussen of Chicago, in recognition of her work among the Norwegians in this country.

PROFESSOR P. J. VAN RHIJN has been appointed director of the Astronomical Laboratory at Groningen.

DR. M. DORSET, chief of the Biochemic Division, Bureau of Animal Industry, Department of Agriculture, has been appointed by the United States government to cooperate in an unofficial and consultative capacity with the advisory committee on anthrax set up by the International Labor Organization.

IT is announced in *Nature* that at a meeting of the Chemical Society on October 5 Professor J. F. Thorpe had been nominated to fill, until the next annual meeting, the office of treasurer, rendered vacant by the resignation of Dr. M. O. Forster, recently appointed director of the Indian Institute of Science at Bangalore. Dr. J. T. Hewitt was nominated to fill the vacancy in the list of vice-presidents caused by Professor Thorpe's appointment.

AT a meeting of medical women held recently in Toronto preliminary steps were taken to form a Canadian Medical Women's Association. Dr. Sproule-Mason was appointed acting president and Dr. Isabel Ayre, of Toronto, was appointed acting secretary. Dr. Jennie Smillie attended the recent International Conference of Medical Women at Geneva as a delegate from this Canadian association.

AT the Cleveland meeting of the American Pharmaceutical Association, the following grants were made from the Research Fund: To D. I. Macht, of the Johns Hopkins University, for pharmacological work on benzyl compounds, $200; to Albert Schneider, Portland, Oregon, for chemical and pharmacological work on chaparro amargosa and on sodium cinnamate, $200.

FRANCIS MAIDL, of the National Museum of Vienna, has been appointed curator of the department of entomology at Cornell University.

DR. BENJAMIN C. GRUENBERG has resigned from the United States Public Health Service, Washington, where he has for the past two years worked on the government's program of sex education in high schools and colleges, to study the problems of the educational use of motion pictures with the Urban Institute, Irvington-on-Hudson, New York.

PROFESSOR WILLIAM TRELEASE, head of the department of botany of the University of Illinois, spent the past summer in a study of types of American peppers at the botanical centers of Kew, Brussels, Paris, Geneva, Berlin and Copenhagen.

DR. BARTON WARREN EVERMANN, director of the California Academy of Sciences and the Steinhart Aquarium, sailed from San Francisco on the *S. S. Maui,* on October 18, to attend the Pan-Pacific Commercial Conference held in Honolulu from October 25 to November 8. Dr. Evermann was appointed the official delegate to represent the following institutions: National Research Council, National Academy of Sciences, California Academy of Sciences, Pacific Division of the American Association for the Advancement of Science and the San Francisco Chamber of Commerce. A paper was presented by him at the conference entitled "Conservation of the marine life of the Pacific."

DR. AND MRS. ALEXANDER HAMILTON RICE are planning another expedition to South America during the coming winter, to continue their explorations.

PROFESSOR EMMANUEL DE MARGERIE, director of the Geological Survey of Alsace and Lorraine, who has just arrived in the United States, will deliver a lecture on "France's contribution to geology and geography in the last hundred years," before the Section of Geology and Mineralogy of the New York Academy of Sciences on the evening of November 6, at the American Museum of Natural History. At the last meeting of the section on October 2, Professor E. W. Berry, of the Johns Hopkins University, lectured on "The geological history of South America."

DR. AUGUSTUS TROWBRIDGE, of Princeton

University, on October 26 lectured before the Franklin Institute on "Highspeed photography of vibrations."

THE *Journal* of the American Medical Association states that the faculty of medicine of the City of Mexico recently organized a ceremony in honor of Laveran, the French army surgeon who discovered the malaria parasite. Representatives of various scientific societies, the directors of the faculties and the dean of the university took part in the tribute. Laveran died in May.

THE library committee of the New York Academy of Medicine will be glad to receive memorabilia, such as letters, manuscripts, photographs, engravings or pictures of any kind relating to the life or work of Louis Pasteur. These will be used for the academy Pasteur celebration from December 27 to January 10. All communications should be addressed to Mr. J. S. Browne, librarian.

DR. ALBERT AVERN STURLEY, instructor in physics at Yale University and formerly professor of physics at the University of King's College, Windsor, N. S., died in New Haven on October 22, at the age of thirty-five years.

COLONEL E. H. GROVE-HILLS, F. R. S., treasurer and ex-president of the Royal Astronomical Society, died on October 2.

THE death is announced of Dr. Tourneux, professor of histology at the University of Toulouse.

PROFESSOR H. BATTERMAN, formerly professor of astronomy at Königsberg University and director of the University Observatory, has died at the age of sixty-two years.

WE learn from *Nature* that in the will of Prince Albert of Monaco, who died on June 26 last, there are several gifts for scientific purposes. His farm at Sainte Suzanne is left to the French Academy of Agriculture, and the wish is expressed that the estate should remain a place for agricultural experiments, to demonstrate what science can obtain from sterile lands. Dr. Jules Richard will receive 600,000 francs to enable him to complete literary and scientific works in progress, including the results of the oceanographic cruises and the preparation of the Bathymetric Chart of the Oceans. The proceeds of the sale of the yacht *Hirondelle,* all books and publications of a scientific nature, as well as certain personal effects, will go to the Oceanographic Institutes at Paris and Monaco, while the Institute of Human Paleontology in Paris is to receive any personal effects relating to the work carried on there. The Paris Academy of Sciences will receive a million francs, the income of which is to provide a prize to be awarded every two years, the nature of the prize to be indicated by the academy, according to the needs of the moment; a like sum is bequeathed to the Academy of Medicine for a similar prize.

PROFESSOR HIRAM BINGHAM has presented to Yale University the anthropological and archeological collections of the Peruvian Expeditions. These collections are to be deposited in the Peabody Museum when the new building is erected.

THE International Congress of Americanists, which met recently at Rio de Janeiro, decided to hold the twenty-first session of the congress in 1924 in Holland. In 1925 the meeting will be held at Gothenburg, and in 1926 in Philadelphia.

AT a recent meeting of the International Commission on Eugenics, held in Bruxelles, and at which there were present representatives from France, Belgium, England, Holland, Denmark, Norway and the United States, it was voted unanimously to invite the German geneticists to send representatives to the commission.

THE first number has appeared of the *Journal of Biochemistry,* published at Tokyo. It contains contributions written in English, French and German. It is published quarterly under the editorship of Samuro Kakiuchi, professor in the Tokyo Imperial University.

IT is reported in the New York *Times* that at a conference in St. Paul, Minn., the Twin City pastors, representing Baptist, Congregational, Presbyterian and Lutheran churches, on October 26 voted to issue a call for a state-wide meeting of protestant ministers next week to oppose the teaching of evolution in the public

schools of Minnesota. Condemning evolution as "a program of infidelity masquerading under the name of science," resolutions were adopted urging that "Christians throughout the state appeal to the legislature to eliminate from all tax supported schools this anti-scientific and anti-scriptural theory of the origin of man and the universe." The Reverend W. B. Riley, pastor of the First Baptist Church of Minneapolis, the head of the committee calling the state gathering, said that it would be urged to start an injunction suit to prevent public schools, normal schools and the State University from receiving funds from Christian taxpayers for the teaching of evolution. This decision is reported to be the direct result of an address given on the preceding Sunday in St. Paul by William Jennings Bryan, in which the adherents of evolution were denounced.

A FEDERAL statute discontinued on December 1, 1921, all serial publications issued by executive branches of the government, excepting those especially authorized by law. Accordingly, the latest issue of the *Journal of Agricultural Research* was November 26, 1921. This journal carries reports of original research conducted by investigators of the Department of Agriculture and cooperating state experiment stations. During the last congress, an amendment to the statute was passed providing for the printing of journals or other serial publications under certain limitations, among which was included the approval of the Bureau of the Budget. Under date of October 19, 1922, General H. M. Lord, director of the Bureau of the Budget, has informed the secretary of agriculture that the use of funds from the appropriation for printing and binding of the Department of Agriculture is approved for the printing of the *Journal of Agricultural Research,* to be published weekly in the standard octavo size. Manuscripts which are now on hand will accordingly be forwarded to the Government Printing Office immediately, and it is believed that the first issue of the *Journal* of the forthcoming new volume will appear on January 6, 1923.

IN 1921 Stanford University received a grant of $20,300 from the Commonwealth Fund for a study of gifted children, to be conducted by Professor Lewis M. Terman. During the school year of 1921-1922 approximately 1,000 children of the desired degree of superiority were located and extensive data concerning them were secured. This grant has now been supplemented by a second grant of $14,000 from the same source, on the condition that Stanford University contribute an equal amount, which it has agreed to do. The second grant is chiefly for the purpose of securing medical, anthropological and additional psychological data, but a part of the sum is being devoted to a parallel biographical study of the childhood of men and women of genius. The total cost of the Stanford investigation will be in the neighborhood of $50,000.

MR. SAMUEL G. LANCASTER, of Portland, Oregon, Columbia Highway engineer, has purchased and improved a tract of seventy-three acres, on the Columbia Highway, about forty miles east of Portland, known as Lancaster Camp. The home economics and service in camp is in charge of Reed College, the personnel consisting during the summer months of Reed students. Ten per cent. of the first $1,000 earned from dining service goes to the college for scholarships, with an increase of ten per cent. for each successive $1,000, up to the first $4,000 earned, fifty per cent. of all such earnings thereafter going to the scholarship fund, the remainder to be used in beautifying the grounds, which are to be kept in perpetuity. The scheme was put in operation in the spring of 1922.

AT the recent meeting of the American Electrochemical Society, in Montreal, an advisory committee was appointed to consult with the Bureau of Mines on its electrometallurgical research work and to recommend to the bureau lines of research and investigation. The membership of the committee is made up of the following, who are also members of the Electrothermic Division of the American Electrochemical Society: Robert Turnbull, *chairman,* J. A. Seede, Dorsey A. Lyon, F. W. Brooke, E. L. Crosby, Acheson Smith, Colin G. Fink, C. A. Schluederberg. The bureau will send monthly progress reports of its electrometallurgical work to the members of this committee. Among the suggestions for research work which the committee has already made to Dorsey A.

Lyon, chief metallurgist of the Bureau of Mines, are: specific heats at different temperatures, refractories, expanding of refractories, and spalling of refractories.

AT the annual meeting of the State Federation of Pennsylvania Women on October 12, at which more than 600 women were present, the following resolution, with possibly fifteen or twenty dissenting votes, was adopted·

Whereas, It has been conclusively demonstrated that the health and happiness of hundreds of thousands of animals, and of many millions of human beings, have been promoted and their lives prolonged by the application of knowledge obtained through scientific experiments on animals; and

Whereas, These researches are conferring a wonderful boon upon the starving nations by constantly adding greatly to the food supply of the world; therefore be it

Resolved, That the State Federation of Pennsylvania Women, assembled in annual general convention in the city of Reading, Pennsylvania, on the twelfth day of October, 1922, hereby put on record their gratitude to medical science for past discoveries so profoundly beneficial to human beings and to animals, and we believe that such beneficent researches should be continued and encouraged.

THE State Department has issued invitations to one hundred and fifty countries to take part in an international congress on dairying to be held in this country in October, 1923. The program, in addition to topics of interest to the industry at large, will include recent advances in the sciences related to dairying and particularly the significance of milk and milk products in nutrition. The chairman of the program committee is L. A. Rogers, Dairy Division, United States Department of Agriculture, and the chairmen of the four sub-committees are: C. H. Eckles, University of Minnesota, St. Paul, Minnesota; O. F. Hunziker, Blue Valley Creamery Company, Chicago, Illinois; Fred Rasmussen, secretary of agriculture, Harrisburg, Pa.; H. C. Sherman, Columbia University, New York.

AT the meeting of the League of Nations committee which was held at Geneva, it was decided that arrangements should be made to hold an international congress of the universities of all countries. The subcommittee charged with the arrangement of this congress was instructed to prepare a report on the following topics: The exchange of professors and of students; the equivalent values of university courses and degrees; the institution of international scholarships, of international vacation courses, and of a central office for information on university matters.

UNIVERSITY AND EDUCATIONAL NOTES

FOSTER HALL, the chemical laboratory of the University of Buffalo, designed especially to meet the needs of the electro-chemical, hydro-electric, dye and steel industries on the Niagara frontier, was dedicated on October 27 in connection with the installation of Dr. Samuel P. Capen, of Washington, as chancellor of the university. Dr. Edgar F. Smith, president of the American Chemical Society, and Dr. Edwin E. Slosson, of Science Service, were speakers at the ceremony. The laboratory, erected at a cost of a million dollars, is the gift of O. E. Foster, of Buffalo.

DR. JOHN STEWART, dean of the faculty of medicine of Dalhousie University, Halifax, laid the cornerstone of the new medical science building for Dalhousie University on September 29.

AT the meeting of the Yale Corporation held on October 14, Professor Richard Swann Lull was appointed director of the Peabody Museum of Natural History for a term of five years. Professor William Ebenezer Ford was elected curator of mineralogy in the museum, to succeed Professor Edward Salisbury Dana, who retires from the curatorship after a service of nearly fifty years. The corporation passed a vote in appreciation of Professor Dana's services.

DR. G. R. LYMAN, plant pathologist in charge of the Plant Disease Survey of the U. S. Department of Agriculture, has been appointed dean of the College of Agriculture of West Virginia University, where he will have supervision of the three divisions of agricultural work of that institution, which include the resident instruction in the College of Agriculture, the work of the Agricultural Experiment Station, and of the Extension Service.

Dr. Lyman will enter upon his new duties on January 1.

PROFESSOR LEROY PATTON, formerly of Muskingum College, Ohio, has been appointed associate geologist of the Bureau of Economic Geology in the University of Texas. Dr. E. H. Sellards, who has been with this bureau several years, has been promoted to be chief geologist, Professor T. L. Bailey, from the University of California, has accepted the position of assistant geologist, vacated by Professor W. S. Adkins a year ago, and Miss Dorothy Shoaf, from the University of Chicago, has been appointed curator of the collections.

DR. J. L. SHELLSHEAR, of Sydney, Australia, has been appointed to the chair of anatomy in the new College of Medicine of Hongkong University.

DISCUSSION AND CORRESPONDENCE

NOTE ON THE DISSOCIATION OF CARBON IN THE INTENSIVE ARC

SOME two years ago while experimenting with the extremely powerful arcs used in the Sperry search lights we noted the singular color and peculiar spectrum in the "negative tongue" which appears at currents of 100 amperes and upwards. It develops rather suddenly as a core of the negative flame, suggesting the inner cone of a blast lamp save in color, which is pale purplish.

The spectroscope disclosed a small number of clearly marked lines superimposed on fainter hazy and complex bands, due to the surrounding arc flame. Examining the tongue spectrum of the lines from time to time, we found substantially the same spectrum from various makes of unmineralized carbons, foreign and domestic. Finally, using a five inch achromatic condenser to throw the image of the tongue on a ground glass we examined it in detail with a direct vision spectroscope equipped with a scale, comparison prism and holder for spectrum tubes.

We thus found as characteristic of the tongue spectrum, some fifteen well defined lines. Of these, seven were good coincidences with the most conspicuous of the well known helium lines, and two others with Hα and Hβ.

The He lines were wl: 7066, 6678, 5876, 5048, 5016, 4922, 4388.

Five of these lines belong to the single line, so-called Parhelium series, being the brightest lines of the principal and second subordinate series, and the three of the first subordinate series.

Of the doublet system the chief lines of the sharp and diffuse series respectively appear, not very brilliantly, while we have not yet detected any of the enhanced series. All indications point to the dissociation of a certain proportion of carbon nuclei with the consequent appearance of He due to the immense concentration of energy in this 150 ampere arc. The H lines may be due to water-vapor absorbed by the soft carbon core, or perhaps to further dissociation. We are now setting up a concave grating spectrograph for the closer examination of the tongue spectrum under much higher dispersion, and hence with a less obtrusive background. We hope that the evidently very high ionization power here manifested may lead us to interesting developments with still other elements.

Our thanks are due to the courtesy of Mr. Sperry in extending the great facilities of his laboratory.

LOUIS BELL
P. R. BASSETT

THE DETERMINATION OF FAT IN CREAM

TO THE EDITOR OF SCIENCE: The authors (E. G. Mahin and R. H. Carr) of a paper on "Errors in the Determination of Fat in Cream," read at the Birmingham meeting of the American Chemical Society, have experienced considerable surprise at the tone of a letter by H. W. Gregory, appearing in the issue of SCIENCE for September 15, 1922, in which he discusses our work upon this subject. Professor Gregory has based his criticisms upon a mere advance abstract, containing no details of experiment or reasoning, and without adequate knowledge of the real points at issue.

In the original paper by Mahin and Carr (not yet published) we have simply called attention to a hitherto unsuspected error in the almost universally used "glymol" method for making fat readings in the Babcock tests on

cream, and we have stated very plainly that there is little or no error if the glymol is added slowly, with the tip of the pipette resting against the neck of the bottle *near the butter fat layer* but (and this is the important point) that by the manner in which the glymol is likely to be added by the average dairy helper there is nearly always an error in the direction of low readings.

That this conclusion was entirely justified will, we believe, be apparent when we state that the results quoted in the original paper were obtained in Professor Gregory's own laboratory, both of the authors watching the tests as they were made in a purely routine manner, by the regular tester and upon creams as they were received in the laboratory. We made no suggestions to the tester, merely asking permission to take readings before and after each addition of glymol. Our observations were confirmed by the tester at the time they were made.

That this is not to be taken as a criticism of the work of the tester, or as a charge of carelessness or wilful negligence, or of lax administration of any laws bearing upon the subject, should be evident when we state that it was only after a considerable amount of subsequent experimentation that we stumbled upon the explanation of the error, which is to be found in the fact that the tester usually follows the very natural method of placing the tip of the pipette just inside the top of the bottle neck, then allowing the oil to flow at the full delivery speed of the pipette into the bottle. This *cause* of error was discovered in March, 1922, and it seems obvious that Professor Gregory's inspectors could not have found and checked the incorrect method for 1,800 or more testers *during the past year,* when neither they nor we nor (so far as is known) any one else knew that the method was incorrect.

We regret very much that our statement regarding the importance of the error in Indiana was interpreted as a charge that Indiana creameries "are beating our producers out of $20,000 worth of cream per year." The case of ten Indiana creameries was cited merely because we happened to have approximate figures on production for 1917 and no charge of this kind was made or even remotely intended. However, because of possible similar misinterpretation by others, we shall gladly delete this paragraph from the paper, as it adds nothing to the scientific value of the latter.

One further misquotation should be noted. In the discussion of the use of various non-miscible oils for this purpose we mentioned the trial of several of these, citing the work of Eckles on fat-saturated amyl alcohol. Of all of the liquids tried, we found that amyl alcohol so prepared was the only one that did not cause a change in readings and we so stated but, far from recommending the use of this liquid, we stated various objections to it and finally concluded that the use of *all* such fluids should be abandoned. Professor Gregory has cited an experiment in which amyl alcohol lowered the fat reading after standing ten minutes but in this experiment, according to his own oral statement, he omitted the very important detail of first saturating the alcohol with butter fat. The conclusion seems fairly obvious. The advance abstract of our paper did not mention this point but, as already noted, an abstract can not go into experimental details.

We understand that quite lately the laboratory in which our observations were made has begun the use of a much lighter hydrocarbon oil than the one formerly used. We do not know whether this has diminished the error but we think it quite likely. If so, we have here another variable, in the variation in specific gravity and viscosity of the oils in general use for the purpose, where limits are not specified for these properties.

In conclusion, we do not believe that this, or any other scientific question, can be settled by denials or display of feeling, but that the laboratory is the only place where a decision can be reached and we offer, as the simple solution of the matter, that each one who is interested shall try the two methods of adding glymol, making observations for himself. We have no doubt that evidence will be found both for and against our conclusions *because the essential defect of the glymol method lies in its variable possibility of error.* But if our statements are "incorrect truths," polemics will not

be required to prove them so. Laboratory experiments are far more reliable.

E. G. MAHIN,
R. H. CARR
PURDUE UNIVERSITY

NOTE ON A DAYLIGHT METEORITE

THINKING that it might be of interest to readers of these columns, the writer calls attention to the following phenomenon observed by him while traveling by canoe on Lake Kipawa, Quebec, on August 31 last.

The day was particularly bright and cloudless, with a southerly wind blowing at about eight miles an hour. The time of the observation was 9:50 a. m., and the course of the canoe was almost directly south. The meteorite was suddenly seen to shoot across the course of the canoe from east to west, about 50° above the horizon, and, as far as could be judged, between 200 and 300 feet above the surface of the lake. Its passage lasted approximately three seconds from the time that it was first noted a little to the left of the bow of the canoe. The general impression received was that of a brilliant Roman candle shooting across the sky, of a vivid copper-green color. The size of the incandescent head of the body appeared to be a trifle larger than a golf ball with a bright incandescent streamer of nearly three feet in length behind it and of a like color. In the wake of the body trailed a curling wreath of white vapor of considerable length which became quickly dissipated.

The passage of the meteorite was accompanied by no detectable noise whatever, so that the other occupant of the canoe, whose gaze was directed elsewhere at the time, failed to see the occurrence. The body suddenly vanished about a hundred yards to the west about the original altitude, leaving a small cloud of white vapor behind that dissolved rapidly away. Although watch was kept on the surface of the lake beyond, no trace of a body falling into the water was noted. It is possible that either it was completely combusted at that moment, or it passed out of sight rapidly along its westerly course.

NORMAN MACL. HARRIS
DEPARTMENT OF HEALTH OF CANADA,
OTTAWA, ONTARIO

HOWARD ON CHEMICAL SPELLING

O Leland tell me, tell me true,
The explanation's up to you,
Why did you break the portals down
And jump into the Chemist's town?
But wait a minute: Now I see,
To solve the riddle's up to me;
You still are in your own domain
Where you without a rival reign,
For as the fact appears to me
You're trying to catch that spelling bee.

H. W. WILEY

QUOTATIONS

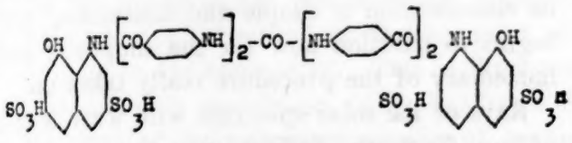
"BAYER 205"

A CURIOUS illustration of the German desire, not unnatural in itself, to regain the tropical colonies lost by the folly of the rulers of the German Empire, is afforded by a discussion which took place at a meeting of the German Association of Tropical Medicine at Hamburg. We have not seen a full report of the meeting, but the *Times* correspondent in Hamburg reports that one of the speakers said that "Bayer 205 is the key to tropical Africa, and consequently the key to all the colonies. The German government must, therefore, be required to safeguard this discovery for Germany. Its value is such that any privilege of a share in it granted to other nations must be made conditional upon the restoration to Germany of her colonial empire." Some account of the drug manufactured by the Bayerische Farbwerke and provisionally named "205" was given in our issue of May 20 (p. 807), when we quoted Dr. H. H. Dale's opinion that it was a remarkable curative agent in trypanosome infections. A general account of the probable chemical relationship of "205" is given by Dr. King in the sixth Annual Report of the Society of Chemical Industry (1921).

In 1904 Ehrlich and Shiga discovered the trypanocidal action of trypan red, a compound formed by combining one molecule of tetrazotized benzidine-mono-sulfonic acid with two molecules of sodium naphthylamine disulfonate. In 1906 Mesnil and Nicolle[1] investigated a series of dyes containing amino-naph-

[1] *Ann. Instit. Pasteur*, 417 and 518 xx, 1906.

thalene-sulfonic acid and found that the most active trypanocidal agent was a dye prepared by the Bayer firm. Little notice was taken of this work, and the discovery of salvarsan diverted attention from the trypanocidal dyes to the organic arsenic compounds. The Bayer firm, however, continued to investigate the trypanocidal dyes and discovered that compounds of this type which were not dyes might still be active trypanocidal agents. They took out a large number of patents, and the type of compound to which the firm has paid special attention is represented by the following formula:



A number of substances of this type have been found to be very active trypanocides, and probably Bayer 205 is a derivative of this type. Bayer 205 is a white powder, freely soluble in water, forming a colorless solution, which can be sterilized. Animal experiments[2] have shown that it is an extraordinarily powerful trypanocidal agent, and that a single dose of it will produce immunity to trypanosomes for several weeks or even months. Mayer and Zeiss, for instance, found it cured infection with five different kinds of trypanosomes, that the ratio between the minimal lethal and minimal curative doses was as high as 167 to 1, and that a single dose of 3 mg. rendered a mouse immune to trypanosomes for three months. Recurrences were found to be extremely rare when infected mice were given a single curative dose of the drug.

The various workers have reported curative effects on trypanosomal infections in mice, rats, guinea-pigs, rabbits, dogs and horses. In England Wenyon[3] found that the drug was an extraordinarily effective trypanocidal agent. A brilliant success has been reported in a case of sleeping sickness.[4,5] The case was of a year's standing, and had been treated unsuccessfully with arsenic, antimony and emetine. Four doses of "205," making a total of 3.5 grams, were given. A few hours after the first dose the fever disappeared, and a complete cure appears to have been produced, for four months later there were no signs of recurrence of the disease.

The drug therefore appears to be a trypanocidal remedy of the first importance, and the fact that a single dose confers prolonged immunity to trypanosomes suggests that it will be of the greatest value as a prophylactic. A commission of German doctors is now in Rhodesia testing the drug, and our knowledge as to its action in man will soon be much more extensive. The discovery of "205" promises to mark a great advance in tropical medicine, but it is a remarkable fact that England should be dependent on Germany for this advance in tropical medicine, for at present Germany has not a single colony, while England has the largest tropical empire in the world. It is not a position of which we have any reason to be proud, but its cause is simple. Germany appreciates the value of pharmacological research and we do not.—*The British Medical Journal.*

[2] Haendel and Joetten, *Bull. Instit. Pasteur,* 131, 19, 1921; Mayer and Zeiss, *ibid.,* 133, 19, 1921; Walther and Pfeiler, *ibid.,* 380, 19, 1921; Miessner and Berge, *ibid.,* 380, 19, 1921; Mayer, *ibid.,* 248, 20, 1922; Schuckmann, *ibid.,* 247, 20, 1922.

[3] Wenyon, *British Medical Journal,* 1921, ii, 746.

[4] Muhlens and Menk, *Muench. med. Woch.,* 1488, 46, 1921.

[5] Yorke, *Ann. Trop. Med. and Paras.,* 479, 15, 1921.

SCIENTIFIC BOOKS

Smell, Taste and Allied Senses in the Vertebrates. G. H. PARKER. Philadelphia and London, J. B. Lippincott Co., 1922, 192 pages, $2.50.

This little volume includes chapters on the Nature of Sense Organs, Anatomy of the Olfactory Organ, Physiology of Olfaction, Vomeronasal Organ or Organ of Jacobson, The Common Chemical Sense, Anatomy of the Gustatory Organ, Physiology of Gustation, and Interrelation of the Chemical Senses. In view of the author's long sustained interest in problems of integration of structure and function and his numerous successful experimental

attacks upon problems of this sort in the field of sense physiology, it is needless to say that his survey of the chemical senses is accurate, authoritative and judicious. So brief a summary naturally can make no claim to completeness, but it is a well balanced selection of topics of significance to students of physiology, psychology and allied sciences.

The more theoretical discussions, especially those centering about the genetic relationships of the receptors, naturally enter debatable territory. In summarizing his well-known observations on the organization of sponges, which "possess muscles but are devoid of nervous tissue," Dr. Parker reiterates (p. 21) his belief that in phylogeny differentiated muscles probably preceded nervous tissue. "So far as can be judged these [nervous] elements originated in connection with the previously differentiated muscle and as a special means of exciting it to contraction." This conclusion seems both unphysiological and unsupported by the facts.

That muscle should be differentiated in advance of the receptive apparatus through which it is activated seems *a priori* as improbable as that receptors should be developed in advance of the appropriate effectors. And Parker's own experiments strongly suggest that the so-called muscles of sponges are really excito-motor organs with lowered excitation threshold and that the excitation mechanism is elaborated within them parallel with the contractile mechanism rather than apart and subsequently. Ordinary protoplasm is, of course, both excitable and contractile, and in some unicellar forms (*e. g.*, Diplodinium, Euplotes, Paramecium and others recently described at the University of California) there are excito-motor masses of protoplasm in which these two functions are both highly developed and in various stages of separation physiologically and structurally. In sponges, as in other lowly multicellular forms, the excitation factor can not be regarded as lagging behind the contractile factor in the differentiation of the process and apparatus of reaction, even though the tissue involved may look more like muscle than like nerve.

In the concluding discussion (chapter 8) all receptors are arranged in three groups: (1) mechanicoreceptors (organs of touch, hearing, equilibration, and probably organs of muscle, tendon and joint sensitivity, lateral line organs of fishes and some others); (2) radioreceptors (organs of vision and temperature); (3) chemoreceptors (organs of smell, taste, general chemical sensitivity, and probably some others). This classification is natural and so far as it goes very satisfactory. But when the author adds (p. 180), "To ascertain into which of these three groups a receptor falls it is necessary to know how it is stimulated after which its classification is simple and immediate," one begins to question how far the simplicity and immediacy of the procedure really takes us.

Rays of the solar spectrum with wave length of say .0008 mm. falling upon the retina and upon the skin produce very different excitations. Both organs are by definition radioreceptors, but just "how it is stimulated" we do not know in either case, nor do we know how it comes about that, if sensation follows the excitation, it is of red in one case and warmth in the other.

Similarly, it has been shown by Parker that ethyl alcohol is an excitant of the organ of smell, the organ of taste and general mucous surfaces and by Carlson of the mucous lining of the stomach also. The threshold is different in each of these cases, the typical reactions are very characteristic in each case, and the sensations (if any) are likewise distinct. Now the fact that these four organs are all chemoreceptors, while important, is less significant biologically than any one of the other three criteria mentioned. In fact, the classification of receptors in terms of the effective stimulus has a very limited range of usefulness and the ultimate goal of our endeavors should be to add to the simple determination of the adequate stimulus of a sense organ the physiologically far more significant knowledge of the real nature of the excitation (that is, of the immediate protoplasmic response to the stimulus) and also a codified statement of the typical or physiologically "normal" more remote effects (reaction, sensation). We are at present very

far from the attainment of this ideal, for, as Parker says (p. 180), "The real difficulty lies in the fact that the numerous receptors that we now recognize have undergone varying degrees of differentiation and hence their mutual affinities are extremely diverse."

On the morphological side the difficulties are even greater, and the various attempts which have been made to determine which of the various anatomical patterns of end-organs are more primitive seem rather futile. Protoplasm in general seems to be sensitive to all of the three kinds of stimuli of Parker's classification and morphologically homologous organs seem capable of transgressing our artificial biological laws and "uniformities" in fashion most disquieting to the systematist. This is illustrated by Whitman's description (since confirmed by Hachloy) of the cutaneous sensillæ of leeches, which are tactile in function on the body but in the head become gradually metamorphosed into visual organs, and also by the way in which both olfactory and gustatory organs may serve on occasion as either interoceptors or exteroceptors, with characteristically different central connections and reaction types in the two cases.

No better summary of this phase of the matter can be given than the concluding sentences of Parker's book: "It is because of the repeated differentiations that characterize the evolution not only of the chemoreceptors but of the other groups of like organs that a classification of them or even a simple enumeration proves to be so unsatisfactory. For they are not unitary elements that can be counted like the fingers on the hand nor are they sufficiently co-ordinated to make classifications easy and natural. They are like the whole organism itself in that they exhibit that kind of diversity that characterizes evolutionary flux."

C. JUDSON HERRICK

SPECIAL ARTICLES

PERIGENESIS

I AM presenting here a short preliminary account of the results of a study of the division figures in *Tradescantia virginica* L.

With the methods used, the structure of the chromosome is that of an achromatic cylinder of jelly-like consistency as described by Vejdovsky (1912) in which the chromatin, however, is imbedded in the form of chromomeres rather than a spiral. These bodies are so distinct that in any one optical plane, they can be counted.

They are made up of flocculated chromatin particles which associate together in rather dense masses which are arranged inside of the periphery of the linin cylinder in such a manner that there results a central core of achromatic substance.

The relationships of the chromomeres one to the other seem to be somewhat variable although the chromosome often shows a quadripartite cross-section as figured by Merriman (1904), Bonnevie (1908), and by Nawaschin (1910).

The effect of fixing, imbedding, and staining this structure gives appearances which have doubtless led to the interpretation that it is longitudinally split.

The arrangement of the chromatin particles within the achromatic cylinder may be traced back, in the vegetative stages especially, to the earliest prophases and I do not find anywhere, either in the vegetative or reduction divisions, any further evidence of a longitudinal split so that for the reductions, I agree with Meves and others that there is no side by side pairing of the chromosomes in these stages.

I find as did Suessenguth (1921), in spite of the recent evidence in favor of a parallel conjugation, that the continuous prophase spireme is constricted into the chromosomes in end to end relationships.

Muller (1921), in discussing the work of Troland (1917) says, "If he is right, each different portion of the gene structure must—like a crystal—attract to itself from the protoplasm, materials of a similar kind thus moulding next to the original gene another structure of similar parts, identically arranged, which then become bound together to form another gene, a replica of the first."

From the phenomena in all metaphase figures, inasmuch as I find the separation is not by longitudinal division, I would limit the above quoted process to the stages beginning with

the close of the telophase and closing with the first tendency towards the formation of the spireme or, in other words, to the so-called resting condition.

E. Haeckel described such a process of growth as the *perigenesis of the plastidules* though perigenesis as described by Haeckel is not referred to by Muller.

The sporophyte cell, from the end of the telophase to the beginning of the next prophase, would therefore become, normally, a tetraploid unit with the chromatic contents merely in need of distribution in the case of the vegetative division or, in the case of the reduction division, of random segregation. Actual return to the gametophytic condition is not accomplished till the second division since dyads are separated on the first or so-called heterotypic spindle.

It is assumed that the genes after the genesis of their like, reassemble in such a fashion that they form a continuous prophase spireme thread. It is during this reassembling of the genes, this reorganization of the nucleus, that the phenomena of crossing over may occur as well as perhaps some mutations not due to such factors as non-disjunction, re-duplication, deficiency, etc.

My material was examined in the living condition, by special staining methods of the living cells in sugar suspensions, by *intravitam* staining, and, as a check, by the standard fixing, hardening, and imbedding methods.

Detailed descriptions, drawings, and photographs will be published in the near future.

HAROLD C. SANDS
COLUMBIA UNIVERSITY

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF RUBBER CHEMISTRY

C. W. Bedford, *chairman*
Arnold H. Smith, *secretary*

Committee reports:

Executive: C. W. BEDFORD, *chairman.*
Accelerator: J. B. TUTTLE, *chairman.*
Physical testing: C. O. NORTH, *chairman.*
Discusion of "Methods of Research Testing" by committee.
Analytical Standardization: S. COLLIER, *chairman.*

American conclusions regarding crude rubber: (By title): O. DE VRIES.

Chemical reactions of sulfur terpenes with rubber. I: JOHN B. TUTTLE.

Studies in vulcanization: mechanism of the acceleration of vulcanization of zinc ethyl xanthogenate: H. A. WINKELMANN and HAROLD GRAY. The gaseous, liquid and solid decomposition products of zinc ethyl xanthogenate are shown to have no accelerating value. The activity of zinc ethyl xanthogenate as an accelerator is due to the unchanged molecule.

Effect of certain tread pigments on temperature developed in pneumatic tires: D. F. CRAVER. The paper is a short description of tread compounds used, stress-strain curves of same, theoretical conductivity as calculated by Williams formula, and the actual heating up of tire built with such treads when run on the road, temperatures being taken by means of thermo couple inserted by the awl which was devised by the research department of the New Jersey Zinc Company.

Disubstituted guanidines: WINFIELD SCOTT. Disubsubstituted guanidines function as accelerators as amines and belong to the class of hydrosulfide accelerators only. Diphenylguanidine reacts with hydrogen sulfide and carbon bisulfide to form a trithiocarbonate, with aniline and carbon bisulfide to form a dithiocarbamate and with carbodiphenylimide to form tetraphenylbiguanide. The effect of small amounts of zinc oxide and zinc carbonate on the tensile strength of rubber cured with disubstituted guanidines is quite marked. The relative curing powers of di-p-tolylguanidine, di-o-tolylguanidine and diphenylguanidine are in the order named, the first being the most efficient. It requires 25 per cent. more diphenylguanidine than di-o-tolylguanidine to produce the same acceleration.

Studies in hysteresis of rubber compounds: W. W. VOGT.

Thermal changes during vulcanization: IRA WILLIAMS and D. J. BEAVER. The measurement of the temperature developed in the center of a cylinder of rubber sulfur mixture which is immersed in a constant temperature bath shows that heat is liberated during the first stages of the reaction. An absorption of heat is indicated during the later stages. The extent of these thermal changes has been estimated when stocks of different sulfur and accelerator content were

cured at different temperatures. The relationship between the temperature developed and the per cent. combined sulfur is given.

Zinc oxide in a new physical condition—its effect upon rubber compounds: FRANK G. BREYER.

Reactions of accelerators during vulcanization. V. Dithiocarbamates and thiuram disulfides: G. W. BEDFORD and HAROLD GRAY. The metallic dithiocarbamates are true accelerators of vulcanization. Metallic oxides are necessary to prevent the decomposition of the metallic salts by hydrogen sulfide or to reform them after decomposition. Hydrogen sulfide changes thiuram disulfides to dithiocarbamates and decomposes the metallic salts. Ammonia increases the curing power of both thiurams and zinc dithiocarbamates. These views are supported by chemical data obtained in the laboratory in the absence of rubber.

A method for the measurement of resistance to tear in vulcanized rubber: ERLE C. ZIMMERMAN. A method is presented for measuring the resistance to tear of vulcanized rubber in terms of work. In this test a sheet of rubber 0.1 inch thick is supported between hooks on the ordinary tensile testing machine, and an autographic chart is taken as the rubber is torn. Resistance to tear is expressed as inch-pounds per square inch of rubber torn, in the formula,

$$W = \frac{KA - \frac{Fe}{2}}{Lt}$$

in which "K" is a constant, "A" is the work area on chart, "L" is the distance torn, "t" is the thickness, "e" and "F" are the elongation and force in equilibrium at the end of the test. Some data are given of resistance to tear in zinc oxide and pure gum stocks.

The results of variation in the sulfur and hexamethylenetetramine content on some of the properties of compounded rubber: H. A. DEPEW. A non-blooming compound must not contain more than 1 per cent. of free sulfur calculated on the rubber. Using hexamethylenetetramine as an accelerator, the tensile strength, elongation and maximal area under the stress-strain curve increase with a decrease in the amount of sulfur used, and to a lesser extent are increased by using a large amount of accelerator. The shape of the stress-strain curve is not affected by the sulfur and accelerator content. The vulcanization coefficient at the optimum cure depends on the sulfur content.

An abrasion machine by which comparative wear tests can be made on laboratory test pieces or on sections cut from tire treads: H. A. DEPEW. A simple abrasion machine is described, on which laboratory test pieces or sections cut from tire treads can be tested for comparative resistance to the abrading or rasping influence of surfaces of known composition. The test pieces fastened at one end, only, are held against a common, uniformly moving, abrading surface with a definite uniform pressure. The effect of pressure upon the test piece and the effects of speed and composition of the abrading surface are discussed. A comparison of this method of testing with the loose abrasive method is given. Comparisons by service tests (tires and heels) are also made.

The influence of certain compounding ingredients in hard rubber: W. E. GLANCY. Several articles have been published showing the action of compounding ingredients in soft rubber goods. Very little has been published thus far with regard to the principles of hard rubber compounding. Graphs are shown which indicate the mass action effect of sulfur, the curing properties of lime and magnesia and the loading qualities of M. R., tire reclaim and resin in hard rubber mixtures.

A convenient nomograph for rubber chemists: W. R. HICKLER and W. E. GLANCY. Rubber chemists have frequently use for tables which will be available for converting the cure of a rubber stock from a known temperature and time to a different temperature with corresponding time. A formula has been worked out from experimental values and a nomograph constructed whereby it is possible to quickly find the desired cure.

Rubber softeners: P. M. AULTMAN and C. O. NORTH. The action of rubber softeners on rubber itself has received very scant attention from rubber chemists. The writers in an effort to find out this action heated vulcanized rubber in each of a large number of softeners until total disintegration ensued. The comparative rate of disintegration was also observed by means of a test in which the swelling of the rubber in the softeners was measured. This method was checked roughly. Sulfur, accelerators and both together were added successively to the softeners to find out their effect on the action, with the results that in each case there was an increase in the rate of solvation. The state of cure was also found to have an effect on the results, as the rate of solvation was found to be inversely proportional to the cure. Mixtures of softeners were found to have, in many cases, the average proper-

ties of their components. From these and compounding results, the writers are of the opinion that a definite relation can be worked out between solvating action and the effects of softeners on the stress-strain curve.

The measurement of temperature in rubber articles by means of thermocouples: ELLWOOD B. SPEAR and J. F. PURDY. Measurements of the temperature in rubber articles by thermocouples are all too low where the depth of insertion is not great, 1-3 inches, and where there is at the same time a temperature differential along the buried portion of the thermocouple wires. The correction to be applied depends upon the depth of insertion, the size of the wires constituting the thermocouple, and the temperature differential. A new method is given for measuring the temperature in pneumatic and solid tires. Correction curves are given for use where ordinary thermocouples have been employed.

The limitations of the obscuring power test for compounding materials: ELLWOOD B. SPEAR and H. A. ENDRES. Experimental evidence is presented in this article that the obscuring power test for compounding materials is unreliable and often misleading in the region where the diameter of the particles is in the neighborhood of one fourth the wave length of light, *viz.*, 0.1 mu.

The crystallization of sulfur in rubber and the phenomenon of "blooming." I: HERBERT A. ENDRES. A solution of sulfur in rubber exhibits the same phenomena of diffusion, crystallization and super-saturation as are shown by solutions of sulfur in other solvents. When rubber saturated with sulfur at calendering or vulcanizing temperatures is cooled, the solubility is exceeded and the excess sulfur separates as super-cooled globules, dendrites or stable rhombic crystals, depending upon the rate of cooling. Sulfur bloom is always composed of rhombic sulfur; the stable form at room temperature. It may be caused by crystallization at the surface of the rubber, either directly from solution or by transformation from super-cooled globules or dendrites.

The microscopic examination of rubber compounds containing antimony pigments: A. F. HARDMAN. To secure a section of a rubber compound sufficiently thin for microscopic examination, some method of hardening must be employed previous to sectioning. Sulfur monochloride has been successfully used for this purpose, but the reagent attacks and destroys the identity of the sulfides of antimony. A bath of molten sulfur may be used to produce the required rigidity without materially altering the appearance of the antimony pigments. Photomicrographs illustrating the new method are shown.

The resilient energy and abrasion resistance of vulcanized rubber: H. W. GREIDER. A study has been made of the effects of several compounding pigments upon the abrasion resistance of vulcanized rubber. It was found that gas black gives the greatest resistance to abrasion, followed by light magnesium carbonate, china clay, zinc oxide, colloidal barium sulfate and lithopone, in the order named. There is found to be a relationship, but not a direct proportionality, between tensile strength and abrasion resistance for rubber compounded with reinforcing pigments. Resilient energy gives an approximate index of abrasion resistance with gas black, magnesium carbonate, china clay and zinc oxide, but it is not a measure of abrasion resistance with colloidal barium sulfate or lithopone. The data appear to show that hardness (or rigidity) is also a factor in resistance to abrasive wear. The product of resilient energy and hardness is suggested as an index of toughness. Some principles are suggested which may be of value in compounding rubber to obtain high resistance to abrasion, including the use of high-grade accelerated mixings and combinations of reinforcing pigments in such proportions by volume as to give proper rigidity combined with high resilient energy. Combinations of gas black and magnesium carbonate in suitable proportions are found to give high resistance to abrasion, high resilient energy and considerable hardness and rigidity.

Persistence of calender grain after vulcanization. (Lantern): W. B. WIEGAND and H. A. BRAENDLE.

A study of the relation of the structure of mercaptobenzothiazole and its derivatives to their value as accelerators of vulcanization. (Lantern): L. B. SEBRELL and C. E. BOORD. The preparation of mercaptobenzothiazole derivatives by the methods reported in a previous paper has been extended to include several new mercaptothiazoles not previously described. Other compounds having a similar structure have been prepared and their curing power compared with that of mercaptobenzothiazole. In this way the particular grouping responsible for the activity of mercaptobenzothiazole as an accelerator has been identified. The effect of substitutents in the benzene nucleus of mercaptobenzothiazole upon its activity as an accelerator has also been studied.

CHARLES L. PARSONS,
Secretary